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Thesis

A SURVEY OF THE CHEMISTRY COURSE
IN
THE SOUTH CAROLINA COLORED HIGH SCHOOLS

Submitted by

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In partial fulfillment of requirements for the degree

of Master of Education

1937

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CHAPTER I

INTRODUCTION

Scope of The Investigation

Reason for Investigation.--In the last decade, the drive for better schools for the Colored people of the State of South Carolina has received an increasing amount of recognition. The situation has aroused the attention and interest of a large number of educators throughout the State. Commendable work has been done in recent years in the secondary school field. Many high schools have been accredited by the State and several more will be in a short time. However, the science departments of these secondary schools apparently have not made the same amount of progress credited to other departments. The chemistry and physics courses are generally the least developed in the science departments. Thus, this study is the result of an investigation of the chemistry courses offered in the Colored high schools of the State of South Carolina.

There is a scarcity of data on this subject. Only meager comprehensive reports are available from school reports of the State Department of Education of South Carolina.

Methods and Purpose of the Investigation.--The investigation of the methods and materials used in the Chemistry courses of the Colored high schools of the State of South Carolina was carried out with the assistance of Mr. William Schiffley of the Department of Education of that State. A nine page check list, developed under the supervision of Dr. Roy O. Billett of the faculty of the School of Education of Boston University, was sent out to the Colored high school science teachers of South Carolina. The names of these teachers were sent to me my Mr. William Schiffley. A copy of this check list is to be found in the appendix of this Thesis.

The following four items are the particular aims of the investigation:

(1). To discover the general conditions under which the Chemistry courses are being given--such as the school year in which it is offered; the number of students in each class; and the subjects additional to Chemistry handled by the teacher.

(2). To find out the personal equipment of the Chemistry teacher--his training in Chemistry; his major studies; and the course he may have had in methods of teaching.

(3). To find out the materials used in the

Chemistry courses such as the textbook; laboratory manual; supplementary and outside problems.

(4). To obtain the personal reaction of the high school teachers of Chemistry as to existing obstacles in the course and the possible changes in methods and materials for making it more effective.

Distribution of the checking list.--On March 7, 1937, forty-five checking lists with a lwtter to each teacher explaining the purposed of the investigation were sent out. Eighteen of these checking lists were returned between March 18th and March 21st. On March 29th a follow-up letter was sent to each teacher who had failed up to that time to return the checking list. The result of this letter was the return of eleven more checking lists by April 23rd. These replies have served as the basic source of data for this investigation.

Historical Background

In order to understand the reasons for the difficult obstacles, and apparent backwardness in high school science in Colored secondary schools of South Carolina one needs but to read the following quotation:

> "South Carolina during the 18th century forbade the teaching of slaves to read and write and forbade free Negroes to do any teaching at all. During the Civil War large numbers of refugees con-

> gregated at Port Royal and on the Sea Islands and systematic teaching began....
> "Negro Suffrage in South Carolina meant the first definite esbablishment of a public school system for Negroes and Whites and is perhaps the greatest gift of the Negro to South Carolina. The constitution of 1868 provided for free schools regradless of race or color. But schools were not actually opened until 1872 and then were partially closed again in the political revolution or 1876. By the laws of 1877 the control of the schools was placed in the hands of local elective officials and thus the system has continued until our day."1/

This educational system is far from being an effective one. Many educators of both races are interested in a better development of the entire system as it affects Negroes in that State. Mr. W. K. Tate, State Supervisor of Elementary Rural Schools, said in a plain straight forward forceful manner back in 1912:

> The education of the Negro in South Carolina is in the hands of the White race. The White trustees apportion the funds, select the teachers and receive the reports. The county superintendent has the supervision of these schools in his hands. We have expended this year $349,834. 50 in the support of Negro Schools. I never visit one of these schools without feeling that we are neglecting a great opportunity. The Negro School houses are miserable beyond all description. They are usually without comfort, equipment, proper lighting, or sanitation. Nearly all the Negroes of school age in the district are crowded into these miserable structures during the short term which the school runs. Most of the teachers are absolutely untrained and have been given certificates by the county board not because they have passed the examination, but because it is necessary to have some kind of a Negro teacher.2/

1./"S. C. Negro Common School", Crisis Magazine, 34: 330-32, Dec. 1927.

2./loc. cit

This quotation really refers to the elementary schools of many years ago, but nevertheless it gives some light on what might be expected in the secondary school. For after all, if the elementary schools where the foundation of all education is taught is in very bad condition, then the secondary schools cannot be much better off.

The great aim of all education should be to enable its beneficiaries to realize a full and rounded life free from as many disappointments and illusions as possible. In 1918 the superintendent of education of South Carolina in his report pointed out that

> "For the first time in the history of our public school system, the State Superintendent's office has undertaken definitely the betterment of our Negro schools.
>
> "The present welfare and the future progress of the State are indissolubly linked with the development of our entire population. The attitude of the Negro has been appreciative and in my opinion the time has come when the general assembly ought to authorize and direct a campaign for better health and better industrial conditions among our Negroes."1/

With this idea in mind many groups who are interested in the education of the Colored people of South Carolina are lending as much assistance as possible to achieve the end.

1./ Biennial Survey Of Education, 1916-1918, P. 433

> The cooperation of outside agencies is readily acknowledged. Through the cooperation of the General Education Board of New York, the salary and the travelling expenses of a state agent for Negro Schools have been secured.[1]

The development of a great number of first class secondary schools has been a difficult problem and will continue as such for some time. There are many great obstacles to be overcome. Great improvement in the elementary schools must first come about. A completely different attitude in general must be taken by the White group of the State toward the education and progress of the Colored people.

> The task is difficult. Houses, terms, salaries, equipment, standards--all these are low. Funds are limited. A foundation must be built in public opinion and in public support before a definite program can be outlined and undertaken.[2]

More money must be appropriated than has been in the past for the development of a standard Colored high school system.

> To illustrate: in South Carolina, Negroes Constitute 49% of the School population; but in 1932-1933 South Carolina spent $331,932 transporting 29,264 White children to elementary schools and in the entire state only $628 on the transportation of Negroes to elementary schools. It spent $310,154 transporting 17,867 White children to high schools and not one cent on the transportation of Negro children to high schools.[3]

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[1] Loc. cit

[2] Loc. cit

[3] "Dangerous Federal School Aid", Crisis Magazine, 44: No. 2, Feb. 1937

However, even if more money is appropriated for this worthy cause, improvement will not be guaranteed. It will be necessary to revise the present system.

> A few White leaders of South Carolina have pleaded for improvement in the condition of the Negro public schools on the ground that present conditions are merely wasteful.1/

South Carolina is today affording the Colored people of the State a greater opportunity than ever before to prepare their boys and girls for the great conflicts and perplexing problems that they will be forced to grapple with in later life. The schools, even though for the most part inadequate, are improving gradually and reflecting glory in their work. Prior to 1915 public secondary schools for Negroes were practically unknown in the entire South.2/

To quote from a 1915 Bulletin of the Department of the Interior:

> The Howard High School in Columbia is the only Colored public school in the State doing a considerable amount of secondary work. This school is not equal to the work of a full three year high school. Several other schools enroll a few pupils beyond the elementary grades. The State school at Orangeburg offers a four-year secondary course,

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1./ "S. C. Negro Common School," Crisis Magazine, 34: 330-32, Dec. 1927

2./ Ambrose Caliver, "Education Of Negro Teachers," National Survey Of The Education Of Teachers, IV: Pub. U.S. Department of the Interior.

> Of the 1,488 secondary pupils in South Carolina, 1,114 are in 18 private schools. Four-year courses are maintained in 7 of these schools with an attendance of 784. The secondary work of the remaining 11 schools varies from a few subjects above the elementary grades to a full three-year course. The courses of study of most of these schools follow closely the college preparatory or classical lines. Very few have adequate provisions for science or history and social studies.1/

Mr. J. E. Sivearin, the Superintendent of Education wrote in his report of 1922 on page 31, the following words:

> The Negro can now secure anything in South Carolina except Social and political equality.2/

In recent years there has been great improvement in this type of education in this state. At the present time there are over thirty-five public schools doing a large amount of secondary work. However, the field of Science is only slightly developed as the Chart below shows. (For Table I see Chapter II)

From a recent report of Mr. J. B. Felton, State Agent we find this statement:

> We have around 25 high schools that are doing accredited work in the State. These have been accredited by the State High School Supervisor; Some of them have four full years' work accredited and others are developing into this year by year. It is hoped that we shall have at least one of these high schools located in each county within a very few years.3/

1./Negro Education, Bulletin, 1916, No. 39, Vol. II, p. 475, Department of the Interior, Bureau of Education.

2./S. C. Negro Common School." Crisis Magazine,34: 330-32, Dec. 1927.

3./J. B. Felton, "Negro Schools", Sixty-Eighth Annual Report of the State Superintendent of Education of of the State of South Carolina--1936, p. 44-45.

Looked for Achievement in A Chemistry Course

There is a main or ultimate object to all education and each parcel of subject matter in the school must be made to bring out this objective. Thus the writer feels that when a course of study in Chemistry can be so well established in a secondary school that the following achievements can be readily detected, the course has earned a foremost place in the school set-up.

1. The children should become acquainted with the principles and laws (natural laws) governing the universe.
2. The course should endeavor to teach the students the principles and methods of science also the practical applications of social principles.
3. The correlation and relationship of the Chemistry course to other subjects in the school should be emphasized at all times.
4. The children should be made conscious of the interdependence of Chemistry to modern civilization, they should be taught to appreciate the every effort of the Scientist in trying to make this era the greatest of all times.
5. The course should motivate initiativeness and independency of work.
6. The course should link up with the other liberal education studies to dismiss ignorance of the

modern social and economic trend of society.

7. The children should be trained through their work in this department to recognize and acknowledge essential facts and to eliminate that which is irrevelent and unsound.
8. Students with ability should be recognized and stimulated to continue work in this field.
9. The course should point out the tremendous part Chemistry plays in both cultural and industrial achievement of this civilization.
10. The course should aim to develop a better and more useful type of citizens trained in the principles of analysis, always seeking out the essential fact before making a decision.

CHAPTER II

THE CONDITIONS UNDER WHICH THE CHEMISTRY COURSE IS GIVEN

Telescopic View

Table 1. General Data Concerning the Number of Science Instructors Receiving Check Lists, Their Reply And the Number Offering Chemistry.

	Check Lists Sent Out	Check Lists Returned	Number Giving Chemistry	Number Not Giving Chemistry
Number	45	29	22	7
Percentage		62	76	24

Forty-five teachers were asked to take part in this survey. Their names and the schools in which they are employed were sent to me from the office of the Department of Education. Twenty-nine or 62 per cent cooperated by returning the check list with a great majority of the items checked. Twenty-two or seventy-six percent of the returned checking list shows that chemistry is offered in the curricula. Seven indicated that chemistry was omitted from their science set up.

The number of students represented by the twenty-nine of the 64 per cent of the total number of check lists sent out which was returned is 10,110. When we recall that in 1915 there was only one public school in the State offering a scant three year high school course and now, a little over two decades, eighteen of the twenty-nine schools taking part in this survey are giving four year

high school courses; this certainly is evidence that interest has been taken in the last few years in the development of more and better secondary schools in the State.

The Secondary School System

Table II Number And Type of Colored High Schools of South Carolina Participating in The Survey.

Types (1)	Grades (2)	Number (3)
Four Year High	8 - 11	18
Senior High	10 - 12	3
Three Year High	8 - 10	2
Junior High	7 - 9	6
Total		29

A list of forty-five schools offering science was sent to the writer by the Department of Education of the State of South Carolina. It may therefore be assured that these were the only high schools for Colored children with science courses recognized by the Department of Education. According to the tabulated findings from the check lists returned by the schools participating, it is difficult to determine where the secondary school level begins. Table II shows that there are at least four types of schools doing some amount of high school work. Of the twenty-nine that returned the check lists, eighteen were classed as four year high schools; three as senior high; two as three year high and six as junior high schools. The four year high schools start with the eighth grade and end with the eleventh grade. Those considered as senior high begin with the tenth and go through the twelfth

grade. The three year high school type includes the eighth through the tenth grade. The Junior high type consists of three grades--seventh, eighth and nineth. It is apparent that the colleges of the state encounter some difficulty in classifying the graduates of these schools. There is a situation wherein students seeking admittance after finishing eleven grades and another group after completion of twelve grades, that must be perplexing to college administrators.

One teacher of a four year high school did admit that even though the school is classified as a four year high school only the first two grades, the eighth and nineth are accredited. Thus evidently certain criteria of standard tenth and eleventh grade work have not been met. This brings to mind that there might be others operating under similiar conditions.

The Grades in Which Chemistry Is Taught

The returned check lists indicate that chemistry is being taught in the tenth and eleventh grades in the schools offering the subject. This, however, does not necessarily mean that the students are thereby better prepared to pursue the course in chemistry offered, for among the obstacles enumerated by teachers in reply to the check list, the following were reported:

1. Students are often permitted to take chemistry

without a fair knowledge of mathematics.

2. The students have hardly any previous training in definiteness of speech.
3. Students often do not have a good foundation in science before taking up chemistry.

The Number of Students in The Chemistry Classes

According to reports of the teachers questioned as to the enrollment of pupils in chemistry the number given varies from 10 to 184 students. A few of the teachers of large classes in chemistry complain that large numbers in one class with poor equipment and facilities tend to limit the interest of the students in chemistry. Some teachers with smaller groups feel that they are at a disadvantage due to the number of other subjects they are called upon to handle besides their own course of chemistry.

Additional Subjects for The Chemistry Teachers

The following table will illustrate the diversity of subjects handled by the teachers reporting.

Table III Number of Colored High School Chemistry Teachers of South Carolina And The Number of Different Departments in Which They Are Required To Teach

Number of Different Departments (1)	Chemistry Teachers (2)
1	8
2	9
3	7
4	5
Total	29

The check list also brought out the following combinations of subjects taught by the various chemistry teachers.

Chemistry, French
Chemistry, Physics, Athletics
Chemistry, Biology, English
Chemistry, Biology, General Science, French, Athletics
Chemistry, Biology, General Science, Physics, Athletics
Chemistry, Biology
Chemistry, Biology, General Science, Mathematics, Commercial Geography
Chemistry, Biology, Geometry, Athletics
Chemistry, Economics, French
Chemistry, Biology, Geometry, Physics, Algebra

Apparently from this information many of the teachers of high school chemistry find themselves burdened with such a heavy schedule that they are unable to do much reading of current scientific literature. This probably results in the final analysis, in the teachers becoming dissatisfied and disappointed with the complete lack of personal progress.

Type of Science Subjects Offered

Table IV Number of Schools Offering Different Science Subjects.

(1) Number of Schools	(2) Science Subjects Offered
29	General Science
2	Physiology
27	Biology
0	Botany
12	Physics
22	Chemistry
0	Zoology
0	No Science

The above table points out the fact that all schools reporting have general science in their curricula; 27 offer biology; 22 give chemistry and only two give any form of physiology or health courses. Botany was not checked on any list. No doubt this subject is offered as a part of the biology course.

CHAPTER III

THE TRAINING OF THE CHEMISTRY TEACHER

Preparation in The Subject-Matter

Table V The Number of Different Courses in Chemistry Studied by Teachers of That Science

	Number of Replies	Gen. Chem.	Organic	Qualitative	Quantitative	Industrial	Physical
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Number	28	28	22	19	17	3	4
Percentage			79	71	61	11	14

The indication from Table V which concerns the training of the chemistry teachers is that all teachers have had general chemistry; but the number of teachers with advanced courses in this subject gradually decrease as the subject reaches a higher stage of complexity. It may be concluded from the number that have studied Industrial (advanced quantitative) and Physical chemistry that less than one half of the Colored high school chemistry teachers replying to the check list have specialized in chemistry. These courses are generally offered in the junior and senior years of college chemistry and are selected by those concentrating in chemistry.

Again in Table V, tabulations show that 22 had studied organic chemistry. The large amount of organic chemistry now being introduced in the modern high school textbook will no doubt be a source of difficulty to the teachers who neglected to study organic chemistry in college.

Teachers' Preparation In The Science Field

Table VI The Number of Colored High School Teachers of South Carolina Who Reported The Number of Semester Hours Taken in The Field of Science

Science Courses	Semester Hours						Total Number Replying
	1-6	7-12	13-18	19-24	25-30	over 30	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
General Science							
Physiology	14	2					
Biology	10	5	3			1	
Botany	7	1					
Physics	16	3					
Chemistry	9	6	4	8		1	
Zoology	14	2					29

The period of time given to the study of science subjects by the chemistry teachers is classified in terms of semester hours in Table VI. A large number of science courses are mentioned as being pursued for a period of one school year or two semesters. Eight teachers have done more than 9 semester hours in chemistry and one has completed over 30 in this subject. It appears that there is a definate trend toward concentration in fields of biology and chemistry in preference to the other sciences. Several of the chemistry teachers have majored in such subjects like mathematics, languages and sociology. One teacher reported that his training in biology amounted to over 30 semester hours. Sixteen teachers stated that they have had only one year's study in the field of physics and three have had two years. Very few teachers have taken over two years of any one science.

Time Spent in College

Table VII College And Universities Where The Colored Science Teachers of South Carolina Were Educated

Name of College or University (1)	Less Time than required for Bachelor's (2)	Bachelor's Degree (3)	Master's Degree (4)	Other Degrees (5)	Other graduate work (6)
Johnson C. Smith University		2			
Benedict College		6			
S.C. State A. M. College		7			1
University of Chicago		1			

Table VII (Concluded)

Ohio State					1
Claflin University		2			
Talladega College		2			
State Teachers' Col. Of Mo.		1			1
Hampton		1			1
University of Iowa			1		
Duke University					1
Southwestern Col Kansas					1
Columbia Univ.					3
Fisk University		1			
Allen University		3			
Barber Col. for Women		1			
N. Carolina A. & T. College		1			
N. Carolina State College		1			
Kansas State College					1
Total		29	1		9

According to Table VII each science teacher taking part in this survey has his or her bachelor's degree from some accredited college. Seventeen of these instructors received their first degree from Negro colleges of South Carolina. Several graduates of such class A Colored colleges of other Southern States like Johnson C. Smith, Talladega and Fisk are employed as science teachers. One teacher received his bachelor's degree from the University of Chicago. The returned check lists indicate that there is one teacher of science with a master's degree. This degree was conferred by the University of Iowa.

Table VIII The Number And Percent of Colored Chemistry Teachers of South Carolina Who Have Received Degrees from Various Colleges And Universities.

Source of Degree	Bachelor's Degree		Master's Degree	
	Number	Percent	Number	Percent
(1)	(2)	(3)	(4)	(5)
Johnson C. Smith University	2	7		
Benedict College	6	19		
So. Carolina State College	7	24		
University of Chicago	1	3		
Claflin University	2	7		
Talladega College	2	7		
State Teachers' Col. Mo.	1	3		
Hampton College	1	3		
University of Iowa			1	3
Fisk University	1	3		
Allen University	3	10		
Barber College for Women	1	3		
N. Carolina A.&T. College	1	3		
N. Carolina State College	1	3		
Total	29		1	

Less than one-third of the teachers replying to the check list are doing graduate work in several of the large Universities of the country. Columbia University is the outstanding choice of these teachers. Three of them are enrolled in this institution. Benedict College, a small college in Columbia and South Carolina A.&M. College in Orangeburg together have given degrees to 43 percent of the teachers cooperating in this survey. Seven of these teachers are graduates of South Carolina State College and six from Benedict College. Allen University, another small college, in Columbia has produced three teachers who have taken part in this work, and Claflin University, a neighbor of South Carolina State A. & M. College

in Orangeburg, has given degrees to two people. These four colleges have produced 56 percent of the science teachers taking part in this investigation, and the other 44 percent are graduates of out of State institutions. All of these teachers have earned at least their bachelor's degree and many have gone furtherin various graduate and professional schools of the country.

Fields of Study in Which The Teachers Majored

Table IX The Number And Percent of Chemistry Teachers Who Concentrated in Chemistry.

(1)	Replies (2)	Majored in Chemistry (3)
Number	29	10
Percentage	64	34

A surprising feature appears on careful perusal of the data concerning the training of the chemistry teacher in that only 34 percent of these instructors actually majored in chemistry. Many of them evidently concentrated in such fields like Social Science, mathematics, English, biology and French. The data is not so extensive regarding the preparation in these other fields, since some of the reports received were slightly vague as to the work done in courses. However, even though it might not be possible to claim complete mastery of the subject-matter under such conditions, one must remember that the training of a teacher in a certain subject cannot be taken for an indication of what he might do with it. Apparently then, the chief contribution of these teachers to their

work is enthusiasm, experience and judgment. In such a case the students are more fortunate than if they had specialists who are interested only in the scientific knowledge to be gotten from the textbooks and notes and the impressing of this on the students rather than guiding the young people to know and appreciate organized knowledge.

Professional Courses in Education

Table X The Various Courses in Methods of Teaching That The Chemistry Teachers Have Studied.

(1)	Replies (2)	Principles of Teaching in Sec. Schools (3)	Methods in Agriculture (4)	Methods in Science (5)
Number	28	22	2	15
Percentage		79	7	54

In Table X, the tabulated replies to the check list show that all of the teachers have had courses covering the general principles of high school teaching. Such courses are no doubt, prerequisites for the granting of the high school teacher's certificate. Seventy-five per-cent of these teachers have had courses in the principles of high school teaching. A large percentage have also had courses in the methods of teaching science. The school system of the State is to be congratulated on this point; however, until the methods in education as taught by advanced educators, are actually brought into the class room, the science of theoretical rather than of practical value.

Teaching Experience

Table XI Number of Colored High School Chemistry Teachers of South Carolina with Total Teaching Experience Who Participated in The Survey.

Total Years of Teaching Experience (1)	Number of Teachers (2)
1	5
2	5
3-5	8
6-10	10
Above 10	1
Total	28

From the reported data it becomes apparent that the instructors of science in these schools are in most cases teachers with some experience. Ten of the reporting teachers have had anywhere from six to ten years teaching experience, eight have had between three and five years experience and one has been in the profession for over ten years. On the other hand, only five teachers have taught but one year, and the same number claim two years experience in this field. In noting the experience of these teachers it is gratifying to know that the great majority of them have been working at their profession for such a length of time that they ought to be a real source of help and inspiration to students in their study of chemistry.

Table XII Number of Colored High School Chemistry Teachers of South Carolina Employed A Given Number of Years by The Schools in Which They Are Now Working

Number Of Years Employed In Present Position (1)	Number Of Teachers (2)
1	7
2	10
3-5	6
6-10	5
Above 10	1
Total	29

Table XII indicates that many of the twenty-eight teachers reporting on questions relating to experience, have not remained in one location during their teaching career. Seven of them have been employed in their present position only one year and ten others have done the same for two years. Instead of an increase in the number of teachers holding their positions at this section of the above Table XII a decrease is to be noticed. Six have held their present positions between three and five years and five held theirs between six and ten years. One teacher has been able to remain in the same position for over ten years.

Regardless of the fact that all teachers replying to the check list sent out have had courses in education the problem of instructing the pupil is still not considered of great importance by a few of them. One instructor frankly wrote: "I do not think much of most of the courses in education. The course should be taught from a scientific point of view and the pupil made to get it without

any sugar-coating." This attitude, however, is common in the teaching profession. Presentation of the subject is of little importance. The stress is on the subject matter and apparently the more difficulty the student has in mastering it is the thing of importance. Thus it might be said that these few teachers do not consider the fact that the real task of science teachers is to aid in bringing the level of public information up to the point where the laymen will be able to use the tremendous amount of scientific information that the science specialists have developed.

CHAPTER IV

THE MATERIALS AND METHODS USED IN THE CHEMISTRY COURSES

Methods of Instruction

The methods and materials used in the chemistry course are given in replies to sections I-F and G, II-A, and all of section III. The answers to questions bearing on the methods used in the chemistry courses are tabulated as follows:

Table XIII. The Various Methods of Instruction Used and The Number and Percentage of Schools Employing Each Type

			Number of Replies 28					
Schools	Percentage	Lecture Periods	Schools	Percentage	Recitations	Schools	Percentage	Laboratory Periods
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
10	50	1	6	30	2	12	60	2 (90 min.)
2	10	3	7	35	3	5	25	4 (180 min.)
3	15	2	5	25	4			

In checking over the length of time spent per day in the class room and laboratory it was found that the schools used class periods of various lengths. However, in all cases, approximately 90 minutes constituted a laboratory period. 13 teachers gave 45 minutes as the

length of a class period; four gave 50 minutes; two mentioned 60 minutes and one did not return a definite reply.

50 per cent of the teachers give only one demonstration-lecture each week; 15 per cent give two; and 10 per cent give three. On the other hand, 35 per cent hold three recitation periods per week; 30 per cent hold two and 25 per cent give four periods to this form of teaching. The majority of the teachers use two 45 minute periods for laboratory instruction. However, 25 per cent of them find it necessary to use four 45 minute periods each week for laboratory work. Many of the group making up this 25 per cent do not use the demonstration-lecture method in the class room.

Table XIII indicates that the lecture-demonstration method of class procedure is not as popular as the recitation plan. 50 per cent give one lecture-demonstration a week and 35 per cent conduct three recitation periods per week. 10 per cent give three demonstration-lectures each week and 30 per cent hold two recitations in the same length of time. The most common form of procedure seems to be three periods of recitation, one of lecture-demonstration and two of laboratory.

A few teachers enclosed with the check list copies of their plans for conducting the chemistry courses.

As a general rule, the plans cover the following procedure:

1. The text book and other references serve primarily as a guide in science courses.
2. Many of the experiments are performed by demonstrations.
3. The experiment to be performed is assigned for study in class. (Supervised study.)
4. Discussion of experiment by the students and instructor.
5. The object of experiment is explained.
6. Careful observation and noting all changes throughout experiment.
7. Study of the physical and chemical properties of final substance.
8. Comparison of physical and chemical properties of final substances with those of initial substance.
9. Calculation if any. (Mathematical).
10. Industrial methods of preparation, if any.
11. Commercial uses, if any.

Materials Used in The Chemistry Course

Table XIV. Textbook Material Used in The Chemistry Class.

Author of Text	Number of Replies 28 Schools Using	Percentage
(1)	(2)	(3)
John C. Hessler	15	54
Brownlee and Others	1	4
Black and Conant	1	4
Geer and Bennett	1	4

Several teachers failed to check the section covering materials used in the course. However, 54 per cent of the number who returned the check list use the text of John C. Hessler. About four per cent use Brownlee and Others while a similar per cent use Black and Conant also Geer and Bennett. No reason was given for the popularity of John C. Hessler. This book is probably used in accordance with requirements of the State course of study.

Table XV. Outside Materials Used in The Chemistry Course.

Outside Materials Used	Number of Replies 28 Number	Percentage
(1)	(2)	(3)
Library References	17	61
Local Industries	7	25
Industrial Problems	9	32
Agricultural Problems	5	18
Household Problems	8	29
Community Interest	4	14
No Use of Outside Material	3	11

According to Table XV, outside material is used to some extent. The most popular source of material apparently is the library of the school. Only 14 per cent try to link up community interest with the course. It is interesting to note that many teachers are making use of industrial, agricultural and household problems in con-

nection with the course.

Several of the teachers claim that science teaching is functioning in the students' school life to the extent that they are anxious to know all about the natural changes that occur in their environments and the laws that govern such changes. The pupils collect all possible biological specimens and make detailed studies of them, both externally and internally. After this, the specimens are preserved and kept for future experiments. They are anxious to perform experiments in chemistry to see the results for themselves and just how they affect the progress of human beings.

Others state that they are able to teach the children the effect of science upon their lives by use of Science clubs and seminars. The idea, apparently is that if a child is subjected to science through clubs, lectures, laboratory work, and tours of local industries, he will eventually learn to like it. One teacher frankly states, "We are trying to make chemistry a living subject."

While these uses of outside materials are significant, still outside material or the students' environment seldom forms the nucleus of the course and is merely brought in to make the existing course in chemistry more palatable. The reverse procedure is the rule--the course exists almost completely formulated in the textbook and the instructor either hands out this material as such or

he may, if he is, so to speak, "kind hearted", sugar-coat this undesirable medicine, by bringing illustrations from the students' environment.

In too many instances chemistry apparently has been taught in a formal way only and carried with it very little of practical value to either the pupil or the community. The subject should be taught in a more practical way. However, one must be cognizant of the fact that chemistry teaching that puts too much stress on practical and local applications without proper stress being placed on the fundamentals of the science may easily degenerate into a conglomeration of isolated or unrelated facts that will not create a lasting impression.

CHAPTER V

EXISTING OBSTACLES AND DESIRABLE CHANGES IN THE CHEMISTRY COURSE

Limiting The Students' Interest and Progress

In replying to the section of the check list that referred to existing obstacles, if any, that tend to limit the interest of the student in the chemistry course, the following table represents the answers given.

Table XVI. Existing Obstacles Encountered in The Chemistry Course Listed By The Teachers Taking Part in The Survey.

Obstacles Given	Number of Replies 28 Number	Percentage
(1)	(2)	(3)
Unrelated to Students' Experience	3	11
Inadequate Text	3	11
Insufficient Laboratory Equipment	9	32
Teaching Too Many Subjects	1	4
Too Much Memory Work	2	7
None Reported	13	46

46 Per cent of the teachers did not list obstacles that tend to limit the interest of the students. However, it is hardly possible to take such silence to this part of the check list as an indication that there are no major difficulties or problems to impede the progress of the pupils in the chemistry set-up where these teachers are employed. Thus replies to other sections of the check

list show indirectly that this 46 per cent have their troubled at least centered around laboratory conveniences, materials, and equipment.

It is gratifying to observe that only seven per cent of the teachers taking part in this survey complain of being given too many subjects to teach. Eleven per cent stated that the chemistry course was unrelated to the student's experience, and a like percentage find the textbook now in use to be inadequate.

In this connection it is significant to note that 32 per cent of the teachers state that insufficient laboratory equipment is an outstanding obstacle to the progress of the students. Chemistry is looked upon as an expensive subject to offer and this fact alone keeps it out of the course of study of many of these high schools. Biology is offered instead, partly because it is less expensive and partly because it is not a very difficult matter for an instructor and his class to go out in the fields and wooded sections and collect specimens for the use in the laboratory. Seven out of the 29 schools that took part in this survey stated that chemistry courses were not included in their curricula. This situation is regrettable when we consider how much this subject contributes to the general intelligence an appreciation of nature and her processes, and the potential training of the individual. The spirit of searching for facts imper-

sonally, regardless of the field of endeavor, needs to be developed in every student. Courses in chemistry, the fundamental science, certainly serves this purpose.

Changes Suggested by Teachers

The teachers who replied to the check list offered several constructive criticisms for the improvement of the chemistry course as now offered. They apparently believe that these suggested changes would make the course more effective. These criticisms are tabulated in Table XVII.

Table XVII. Desirable Changes in The Chemistry Courses As Suggested by The Teachers of The Colored High Schools of South Carolina.

Changes Suggested	Number of Replies 28 Number	Percentage
(1)	(2)	(3)
Improved Laboratory Facilities	12	43
Adapting Course To Local Needs	6	21
Change In Textbook	5	18
Teaching Of Fewer Subjects	1	4
More Outside Material	2	7

The suggested remedies listed in Table XVII shows that the teachers are cognizant of the fact that progress must include above all, improvement of laboratory equipments and facilities. The course must be made less formal in order to relate itself to local problems centered around industry, agriculture, the home and the locality in general.

In Table XVII we find 43 per cent of the teachers suggesting the improvement of laboratory facilities and 21 per cent wishing to adapt the chemistry course to local

needs. In Table XVI 11 per cent of the teachers found the textbook inadequate, but in checking over the tabulations in Table XVII we find that 18 per cent suggested that a change be made in textbooks. Evidently there must be an adequate supply of library and other outside material available because only seven per cent of the group expressed the desire for more such teaching aids.

In view of the fact that it is apparent that these teachers are interested in improving their laboratory equipment and making their course less formal, the writer has placed a specimen of a unit in chemistry in the appendix.

In the final analysis, it appears, that the teachers of chemistry in the Colored high schools of South Carolina have a great problem or task before them. They will, of necessity, be forced to devise plans for selling their subject to school authorities. These teachers will have to shoulder the problem of bringing chemical or scientific information up to the point where the ordinary man will be able to use and appreciate it.

CONCLUSION

While this report is far from complete on chemistry as taught in the Colored high schools of South Carolina, it covers a sufficiently great number of schools to be of value in judging the conditions in general. The writer feels that it is probable that the schools not reporting would have less satisfactory results on the average.

In summarizing the data which was furnished as replies to the checking list, many outstanding facts must be noted. Briefly they may be tabulated as follows:

1. Students are in many instances prepared in science before taking the chemistry course.
2. Many teachers are handicapped by having to handle a variety of unrelated subjects.
3. The lecture-demonstration method is not used enough.
4. There is considerable variation in the training of the teacher.
5. Outside material is not used as an actual part of the course but simply to popularize course.
6. Much dissatisfaction is manifested regarding laboratory equipment and facilities.

7. Many teachers would like to make their course less formal.
8. The course in chemistry is in several schools a textbook subject.
9. There is some dissatisfaction with the textbook now in use.
10. Teachers state that the course now offered is unrelated to the student's life and experience.

It is to be hoped that the time is not far distant when some knowledge of general science and physics at least required for admission to courses in elementary chemistry. Modern chemistry is using more physical terms and laws than in the past; thus without such a requirement the chemistry teacher must devote a large part of his time to the teaching of elementary physics. It is obvious that if the chemistry teacheris to spend a large part of his time teaching physics and mathematical procedures that chemistry will suffer.

In many cases, the chemistry teacher is called upon not only to teach such subjects as physics, algebra and general science, but subjects aompletely out of the science field, and to coach athletics. Little consideration is evidently given to the fact that the laboratory teacher needs free time in which to prepare materials for his classes and correct laboratory papers. It is hardly

possible to expect a teacher with such a program to find time for outside study and reading that will enable him to keep his course up-to-date.

It seems safe to conclude that under ordinary conditions of teaching chemistry in the high schools, the demonstration-lecture method is very effective in getting over the desired information. This method is also a time saver, and should be used more than once each week by those teachers who admitted such limited usage.

All of the chemistry teachers returning the check list had received their first degree, one held an advanced degree and many more were doing advanced work in various fields. This is very gratifying. However, the preparation in chemistry cannot be commended in a like manner. Too small a percentage majored in chemistry. An instructor cannot teach chemistry to a high school pupil adequately and develop a real interest in the youth for the subject, unless that teacher is very familiar with inorganic, analytical, and organic chemistry.

In the matter of outside material, 50 dollars invested in carefully selected reference books will mean a great deal to the chemistry courses in these high schools. The sample unit placed in the appendix might serve as an example of how a teacher might correlate outside material with classroom work. Following such a procedure would enable the teacher to make his course less formal and the

outside material a very necessary phases of the entire course.

Many teachers are dissatisfied with their laboratory facilities and equipment. In many respects the laboratory is the starting place for the instruction in chemistry. It is different from the classroom in that it caters to the individual student wherein the lecture room deals with the class as a group. The laboratory develops a very close relationship between teacher and student. Contacts are very informal.

The laboratory and classroom work can be carried on in the same room. A plan of this type of combination laboratory and classroom may be found in the appendix. It is a copy of a plan drawn by Mr. Edward Sholto Wolcott who received his Master of Education degree from Boston University in 1928.

From this investigation it is found that four textbooks are used in the schools who cooperated with the writer. According to these replies, 50 per cent of the teachers are using First Year Chemistry by C. C. Hessler. The other texts used are, Practical Chemistry by Black and Conant; First Principles of Chemistry by Brownlee, Fuller, Hancock, and others; and Chemistry by Geer and Bennett. A few of the teachers are not satisfied with the textbooks that they are using. These books are among the best known in high school circles. It is possible,

however, that these teachers are looking for a more practical book particularly for those students who are not planning to enter college. A strictly pandemic textbook for high school would probably meet the needs of these teachers.

The course of chemistry should be given under such conditions that it would relate largely to the students' needs, capacity and locality. However, the instructor must avoid the danger of over-emphasizing the practical side of it, at the expense of the fundamental laws and principles of the subject. Teachers can bring chemistry, and science in general, closer to the students by guiding them carefully into more reference reading and industrial plant observation. Science clubs should be organized with regular meetings, for discussions by students and visitors of scientific problems and observations. Parents and friends should be invited to come and take part in these meetings. The educating of the people of the community to appreciate chemistry and science in general is of vital importance. Mr. Harold Sylvester says in his thesis that science has the opportunity, the means and the power to serve the masses so that they will be raised to new attainments and to worthier and more complete living.[1/]

[1./] "Current Tendencies in Secondary School Success." By Harold Dexter Sylvester. Masters Thesis of Boston University, School of Education, 1930.

APPENDIX

South Main Street
Andover, Mass.

Dear Professor

As a graduate student of Boston University School of Education and with the permission and cooperation of Mr. Schiffley of the Educational Department of the State of South Carolina, I am making a study of the true status of high school science, particularly chemistry, in your State. One of the important phases of such a survey is to have each teacher give me first-hand information concerning his own science department. To this end, an information blank or check list is enclosed in this letter to you.

I am well acquainted with the great demands made on your time, for which reason I have tried very earnestly to make this check list simple and easy to complete. It will require less than   minutes of your time to fill out. I would be extremely grateful to you if the blank were filled out and returned to me before   .

Yours respectfully,

Eric Byron Chandler

EBC:MID

FOLLOW-UP LETTER

April 1, 1937

Dear Sir:

You will recall that you received from me in February a check list directed to all Colored science teachers of South Carolina, which I asked to kindly return to me by March 19th. No doubt you have been very busy and a matter of this sort would very easily slip your attention for the time.

I would highly appreciate your assistance if you would return the check list to me by April 12th. I have the highest respect for your work at ---- ---- and would like to give it a prominent place in my writings with all credit to you. Any other information concerning the development and history of high school science in the state that you wish to give will be gratefully received.

Sincerely yours,

Eric Byron Chandler
South Main Street
Andover, Mass.

CHECKING LIST

on

A Survey of the Chemistry Courses in the South Carolina Colored High Schools

Preliminary Information

Name of School ____

Location: City ______________________ County ______________________

Name of Science Teacher reporting ______________________________

Position held ________________________

Directions: Please circle all "yes" and "no" answers; otherwise check (✓). Do not underline any words or phrases.

What type of school is yours?

Please check type of school and circle numbers corresponding to grades included in your school.

Type of School	Grades Included	Type of School	Grades Included
( ) a. Junior High	7,8,9,10,11,12	( ) c. Three Year High	7,8,9,10,11,12
( ) b. Senior High	7,8,9,10,11,12	( ) d. Four Year High	7,8,9,10,11,12

e. What is the total enrollment of the schools? ______________ Pupils

I. The set-up of the science department:

A. Please check the science subjects taught in your school and circle the years in which they are given.

1. Subjects	2. Grades in which taught
( ) a. General Science	7, 8, 9, 10, 11, 12
( ) b. Physiology	7, 8, 9, 10, 11, 12
( ) c. Biology	7, 8, 9, 10, 11, 12
( ) d. Botany	7, 8, 9, 10, 11, 12
( ) e. Physics	7, 8, 9, 10, 11, 12
( ) f. Chemistry	7, 8, 9, 10, 11, 12
( ) g. Zoology	7, 8, 9, 10, 11, 12
( ) h. Others (name them)	7, 8, 9, 10, 11, 12
	7, 8, 9, 10, 11, 12
	7, 8, 9, 10, 11, 12

B. Do you teach all the science in your school? Yes No

C. If answer to "B" is "No", check the ones you are teaching.

( ) 1. General Science
( ) 2. Physiology
( ) 3. Biology
( ) 4. Botany
( ) 5. Physics
( ) 6. Chemistry
( ) 7. Zoology
( ) 8. Others (name them)

D. Please indicate in Column (2) of the following table the number of sections which you have in each one of your science classes. Indicate in columns (3) through (8) the pupils enrolled in each of your sections.

TABLE I

Classes	Number of Class sections	Section 1	Section 2	Pupils Section 3	enrolled Section 4	Section 5	Section 6
	(2)	(3)	(4)	(5)	(6)	(7)	(8)
General Science							
Physiology							
Biology							
Botany							
Physics							
Chemistry							
Zoology							
Others, name them							

E. Check any of the following subjects you are required to teach in addition to your Chemistry courses.

1. Economics
2. Algebra
3. Geometry
4. Athletics
5. Latin
6. French
7. English
8. Commercial Subjects
9. Shop Work

Note: If you are required to teach any other subjects not appearing above, would you kindly list them here?

____

____

____

F. Is the Science department of your school equipped with laboratories? Yes No

1. Please check the seperate laboratories that are to be found in your school.

   a. Biology

   b. Chemistry

   c. Physics

2. If any of the above mentioned laboratories are combined together, please list such combinations below.

____

____

____

3. How many desks are there in the chemistry laboratory?________

4. Are the gas connections on the desks? Yes No

5. Is there running water at each desk? Yes No

6. Have you a chemical storeroom? Yes No

7. Please indicate on the list below the number of pieces of laboratory equipment and quantities of chemicals to be found in your laboratory.

_____test tubes

_____beakers

_____alcohol lamps or Bunsen burners

_____evaporation dishes, porcelain

_____gauze, iron wire

_____assorted rubber stoppers

_____packages of filter paper

_____rubber tubing

_____test tube brushes

_____glass plates

_____sand bath

_____flasks

_____funnels, thistle top

_____mortars and pestles

_____set of weights

_____lb. acid, hydrochloric

_____lb. alum, lumps

_____oz. bromine

_____lb. copper turnings

_____lb. iron chloride /ic/

_____lb. lead sheet or shots

_____lb. marble, lumps

_____lb. ammonium nitrate

_____oz. cobalt chloride

_____bottle of hydrogen peroxide

_____oz. mercurous nitrate

_____lb. potassium permanganate

_____lb. sodium nitrite

_____lb. ammonium sulfate

_____lb. copper oxide

_____oz. mercuric chloride

_____ox. phenolphthalein powder

_____ring stands, with rings

_____files, triangular

_____glass tubing

_____test tube holders

_____test tube racks

_____wide mouth and narrow mouth bottles

_____cork borers

_____funnels, glass

_____graduate cylinders

_____balances

_____chemical thermometers

_____lb. acid, sulfuric

_____lb. baking soda

_____lb. charcoal lumps, wood

_____oz. iodine

_____lb. iron sulfide /sticks/

_____lb. acid, acetic, glacial

_____lb. arsenous oxide

_____bottles of litmus paper, red and blue

_____pkg. gelatin

_____lb. magnesium sulfate

_____paraffin cakes

_____oz. sodium, metal

_____lb. ammonium chloride

_____lb. calcium carbide

_____oz. magnesium ribbon or powder

_____oz. mercuric oxide

_____lb. Plaster of Paris

____oz. potassium chromate

____lb. Sodium acetate

____lb. sodium sulfite

____lb. acid, nitric

____lb. ammonium hydroxide

____lb. calcium chloride

____lb. cabon bisulfide

____lb. copper sulfate

____lb. iron sulfate /pus/

____lb. manganese dioxide

____oz. patassium bromide

____lb. sodium bicarbonate

____lb. sodium hydroxide /lye/

____lb. sugar

____lb. sulfur, roll

____lb. Rochelle Salt

____lb. sodium phosphate--di-basic

____lb. potassium chlorate

____gal. alcohol, denatured

____lb. barium chloride

____lb. calcium oxide, /quicklime/

____cloth, colored and white

____lb. iron filings

____lb. lead acetate

____oz. mercure, metal

____oz. potassium iodide

____lb. sodium chloride

____lb. sodium sulfate

____lb. zinc, granulated

____pkg. sodium tetraborate /borate/

____lb. starch

G. From whom do you receive financial support for your chemistry laboratory? Please check and give amount of support.

1. From the state Amount \$__________
2. From the community Amount \$__________
3. From the students' fee Amount \$__________
4. From the county Amount \$__________
5. Proceeds from public entertainment Amount \$__________
6. Science clubs Amount \$__________
7. Others /name them/ Amount \$__________
8. Amount \$__________
9. Amount \$

II. The training of the Chemistry teacher:

A. On the table below, check the courses that you have studied and in the proper column give the number of semesters or quarters each subject was pursued also number of hours per week class met.

TABLE II

Subjects studied in college	Time given to the subject		
	How many semesters did you study it?	How many quarters did you study it?	How many hours per week did the class meet?
1	2	3	4
( ) Biology			
( ) Botany			
( ) Chemistry			
( ) Physics			
( ) Physiology			
( ) Zoology			
( ) Mathematics			
( ) English			
( ) Latin			
( ) French			
( ) Social Science			
( ) Commercial Subjects			

B. Check any of the following courses in Chemistry which you have studied in college.

( ) 1. General Chemistry

( ) 2. Organic Chemistry

( ) 3. Qualitative Analysis

( ) 4. Quantitative Analysis

( ) 5. Agricultural Chemistry

( ) 6. Industrial Chemistry

( ) 7. Physical Chemistry

( ) 8. Others /name them/

( ) 9.

( ) 10.

C. Check the courses in Education you have studied:

( ) 1. Principles of High School Teaching

( ) 2. Methods of Teaching Agriculture

( ) 3. Methods of Teaching Science

( ) 4. Measurement

( ) 5. Educational Psychology

( ) 6. Educational Sociology

( ) 7. Visual Education

D. The length of your teaching experience is______________years.

E. How long have you been in present position?______________years.

F. List in the proper column the Normal Schools and Colleges attended also diplomas and degrees obtained.

Normal School	College	Diploma	Degree
1.			
2.			
3.			
4.			
5.			

III. The materials and methods used in the Chemistry courses.

A. How many periods per week do you teach Chemistry?

1. Recitation______________periods per week

2. Laboratory______________periods per week

3. Lecture-Demonstration______________periods per week

4. Number of minutes to each period______________

B. Please give the author and name of textbook used__________

____

C. Please give the author and name of laboratory manual used

____

D. If you use outside material in your Chemistry courses, is it any of the following types? Please check.

( ). 1. Library references
( ). 2. Agricultural problems
( ). 3. Household problems
( ). 4. Local industries
( ). 5. Community interests
( ). 6. Individual problems

E. Are your students taking their science work with a definite life aim in mind? Yes No

F. If answer to (E) is "Yes", please write a brief statement explaining how you were able to accomplish the task.

____

____

____

____

G. What measures are you taking to improve science offered and method of instruction?

( ). 1. Looking for some practical plan of instruction

( ). 2. Developing Science Clubs

( ). 3. Relating class room instruction to pupil's interest, needs and abilities.

( ). 4. Contacting parents

( ). 5. Making visits to other schools or nearby colleges

( ). 6. Assisting pupils in choice of vocation

( ). 7. Other methods (Please name them)

H. Is science teaching really functioning in the students' school life? If so, to what extent?

I. Have you an organized plan of instruction? Yes No

J. Will you kindly describe the plan and if convenient, please enclose any mimeographed or printed material describing it?

IV. The existing obstacles and desirable changes in the Chemistry courses

A. Briefly describe the obstacles, if any, that tend to limit the interest of the student in the Chemistry courses.

B. Please explain changes, if any, in present subject-matter and method that would make the Chemistry course meet the needs of the students more effectively.

TITLE OF UNIT

THE CHEMISTRY OF PLANT FOOD MATERIAL IN SOIL

Unit: Nitrogen, phosphorus, calcium, iron, sulfur, magnesium and potassium are elements of the soil which are essential to all plant life. Silicon, chlorine, and sodium are other elements of the soil that are necessary to full development of many plants. Like the human being, the plant must have food, and this food must contain the above mentioned elements. There are different types of soils. Before the application of commercial fertilizers to the soil can be made intelligently the composition of the soil must be studied. A very important constituent of soil is the decomposed organic matter that has become incorporated with it.

Analysis Of The Unit:

1. Soils are formed by the disintegration of rocks and by the accumulation of decayed organic matter.
2. Potassium gets into the soil by the disintegration of clay rocks containing feldspar.
3. A fertile soil contains nitrogen, phosphorus, calcium, iron sulfur, magnesium, potassium silicon, chlorine, and sodium in some form easily assimilated by the plant.
4. A fertile soil is necessary not only to the production of food for the nation, but for the production of over four-fifths of all of the raw materials used in manufacture.
5. Organic matter which is a constituent of soil may be divided into three classes: (1) Undecomposed matter, (2) partially decomposed matter, (3) final product.
6. The composition of the soil can be determined by the analysis of carefully selected samples.
7. Some soils are termed acid or sour soils.
8. There are two kinds of soil acidity (1) when acids are present that have been formed by fermentation of organic matter in the soil, (2) when there is a deficiency of such material as lime or potash.

9. The restoration of fertility to wornout farm lands is a problem for the chemist and agriculturist.

10. Sodium nitrate ($N_a NO_3$) and ammononum sulfate $(NH_4)_2 SO_4$ are soluble nitrogen compounds and are therefore used as compounds and are of great value in extensive farming.

Summary of Unit

Rock material under the influence of weathering, gradually crumbles into fragments of varying size. Temperature changes, the bleaching action of rain, oxidation and reduction, all contribute to the disintegration of the rock fragments into small particles.

There are wide differences in the quantities of plant food materials in soils from different localities. A soil may be rich in one ingredient and poor in another.

Subsoils sometimes contain more and sometimes less plant food materials than do the surface soils. The chemical elements from the soil essential to plant life are calcium, iron, magnesium nitrogen, phosphorus potassium and sulfate. A soil is likely to become deficient in compounds of nitrogen, phosphorus, potassium and sulphur. This deficiency must be made up by substances known as fertilizers. When plant foods are in the soil but not in available form an amendment must be added to the soil. An amendment is a substance added to the soil which through its own power to chemically react with the food elements present willliberate food for the plant.

Compounds such as sodium nitrate, ammonium sulfate, calcium cyanamid, cotton seed meal, guano and dried blood are valuable sources of ni-

trogen for plant food. Rock phosphates are among the best sources for the needed phosphorus. Potassium for plant food is gotten from wood ashes, potassium chloride, kamite and potassium sulfate.

There are two kinds of soil acidity (1) when acids are present that have been formed by fermentation of organic matter in the soil, and (2) when there is a deficiency of such material as lime or potash.

Unit Assignment--What Are The Properties Of Soils That Make It Well Adapted To Furnish Plant Food?

A. Plans for Motivation: Teacher-Pupils Activities:

1. The last day used for concluding work on the preceding unit, the teacher will ask the students to volunteer to supply the class with soils for testing purposes.

Teacher's Demonstration: 2. During the first class period devoted to the present unit the instructor will test some of the soil for acidity and alkalinity.

Charts: 3. The teacher will have some charts and diagrams such as the ones issued by the U.S. Department of Agriculture and the State Schools and Colleges, available for the students' use.

Experiment performed by the teacher, assisted by the students: 4. On the second and third classrom periods, the student will be shown how to make various water cultures of barley and other plants. The class will note from time to time the effect of various elements on the growth of these plants in water. They will see the result of (1) using complete manure; (2) no nitrogen; (3) no phosphoric acid; (4) no potash; (5) no lime; (6) no magnesia. This procedure will prove to them that farm crops always take the above mentioned elements from the soil. They should now understand that when nitrogen, phosphorus and potassium become diminished to a great extent, the soil fails to yield a profitable crop. For this reason nitrogen, phosphorus and potassium compounds constitute the essential ingredients of commercial fertilizers. Likewise that in addition to such compounds, it becomes necessary in some in-

stances to add compounds containing calcium, magnesium and sulphur. Elements taken from the soil in large quantities by crops must be returned to it in the form of suitable compounds, if the soil is not to decrease in fertility. Thus a fundamental lesson concerning economics --a natural law is taught here. Men cannot hope to have something made from nothing.

Inspection trip: 5. Forever keeping in mind, that a good teacher must keep his pupils' interest in their work, the instructor plans an inspection trip to a few nearby well managed farms. This trip is promised to the students to replace the last day in the laboratory and if anything like satisfaction is to be realised it must be carefully worked out. The problem of planning the trip will be worked out with the assistance of the class after agreeing among themselves that the field trip is a real necessity to the carrying out of science.

For the most efficient instruction in this unit, the presentation of basic principles of scientific farming must be clearly and thoroughly enunciated before any trip will be taken. When all the fundamental materials which have been assigned to the pupils have been mastered then the trip will be undertaken. The study of these unit processes should be presented with the aid of a well planned laboratory course, illustrated lectures, discussions and supplemented by numerous problems. For best results to accrue from an inspection trip, a plan of study of the farm and the procedure about the farm must be mapped out with as much care as in the study of fundamentals.

Now the students are prepared to understand what they see. The type of farm visited should be that which offers as wide an application of chemical principles as possible. This necessitates a knowledge on the part of the instructor, of the farm visited and he should have these particular farms in his mind's eye when he lectures on the subject.

In order to get this particular view point the instructor should visit the farms prior to the trip. He should develop the trip about the farm in a manner that will make the inspection of the greatest value to the student. In most instances, the time spent in inspection trips is rather limited so that the farms visited should be considered with the utmost care with regards to the diversity of operations. The farms should be medium size, compact, and above all things, modern.

Without a doubt, the greatest benefits derived from inspection trips are the views presented in the report that should be required of the student. From the student's

report, the instructor can get an insight into the student's tendencies, and will have a foundation on which to base recommendations as to his aptitude for plant production, executive work or future research along purely scientific lines.

Guide Sheet for
Students' Use

Unit Assignment (cont')--What Are The Properties Of Soils That Make It Well Adapted To Furnish Plant-Food?

B. Exercise & Problems:

1. How is soil formed and transported?
    - a. What are the agencies concerned in the formation and transformation of soil?
    - b. What is the action of heat and cold on rocks?
    - c. What is the action of frost and water on rocks?
    - d. What part did the great glaciers play in soil formation?
    - e. Explain the difference between powdered rock and soil?
    - f. What common plant food materials have been lost in greatest quantities by residual soils?
    - g. Why are residual soils likely to be deficient?
    - i. Why are or are not Marine soils usually rich in plant food materials?
    - j. What is a characteristic differences between residual soil

soil and glacial soil when both are formed from rocks rich in plant-food materials?

Laboratory Work: k. Study of Soil-forming Minerals.

Materials: Specimesn of quartz, potash-feldspar, mica, calcite , apatite, gypsum and hematite; also a piece of glass, a knife, dilute hydrochloric acid, hand-lens and flame.

Procedure: Hardness-Try to scratch material with fingernails; cut with glass; scratch with a knife;

Color--Observe color and luster.

Form--Does the specimen seem to have any crystal form that is characteristic and useful in identification?

Action of acid--What is the result if the specimen is treated with a few drops of acid? Explain.

Flame--Hold a small fragment of each mineral in the flame. Note the change of color of flame. Be prepared to identify unlabeled samples in laboratory and field.

L. Soil Structure--

Materials: Puddled and granular soils.

Procedure: Examine under hand-lens a granular and puddled soil. Describe each and make drawings. Discuss each as to probable relation to water movement, penetration of plant roots, ease of making seed beds, etc.

2. What are the properties of soil make it well adapted to furnish plant food?

a. How is the fertility of the soil determined?

b. What relation does soil have to the needs of plants for water?

c. What are the names and properties of the elemental substances that plants derive from the soil?

d. What two substances necessary to plant growth are contained in the earth's crust in the smallest quantities?

e. Conditions for plant growth.

Materials: Small flower pots, rich soil, oat seed.

Procedure: Fill four flower pots with rich garden loam. Moisten well and plant with oat seeds. When seedlings are a week old, thin to desired number of plants. Grow for a few weeks under best conditions, then subject them to the following conditions.

Pot 1.-Sunshine and minimum water.
Pot 2.-Sunshine and plenty of water.
Pot 3.-Cold, Shade and plenty of water.
Pot 4.-Dark and plenty of water.

Observe results and explain. (The interested students may use more pots with other conditions.)

f. Effects of the different plant nutrients.

Materials: One gallon flower pots very poor sandy soil, sodium nitrate, and phosphate, potassium chlorate, barley seed.

Procedure: Fill five flower pots to within an inch of their tops with poor sandy soil.
Pot 1. Sodium nitrate is mixed in.
Pot 2. Acid Phosphate is mixed in.
Pot 3. Potassium chlorate is mixed in.
Pot 4. All three are mixed in.
Pot 5. No fertilizer is mixed in.

Plant a dozen barley seeds in each pot and add water enough to make soil moist. Place pots in moderately warm place. When seedlings are a week old, thin out. Observe results and explain.

4. How does Soil acidity affect Plant life?

a. What is meant by positive and negative acidity in soils?

b. In what three ways may soil acidity be injurious to plant growth?

c. In what ways the growth of plantson soil tends to make it become sour?

d. What is meant by Alkali soil?

e. How may alkali be removed from the soil?

f. What is the effect on soil acidity of a continued use of ammonium sulfate?

g. How is acidity overcome?

h. What crops are adapted to sour soils?

i. What crops are injured by acid soils?

j. Determination of percentage of water in soil:

Materials: Samples of moist soil, balance, evaporating dishes, oven, flame, desiccator.

Procedure: Carefully weigh an evaporating dish. Weigh into the dish 50 grams of the soil to be tested. Air dry sample in the laboratory then place it in the oven at 100° for two hours. Cool in a desiccator and weigh.

The loss in weight is water. Calculate the percentage of moisture based on absolute dry soil.
Make this determination in duplicate and on a number of soils furnished by members of the class.

k. Ammonia Test for acidity

Materials: Soil, bottle concentrated ammonia.

Procedure: Place about 25 grams of soil in a bottle and add 10 c.c of ammonia. Fill two-thirds fill with distilled water. Shake well and allow to stand over night.
Andarkening of the supernatent liquid is an indication of the lack of lime.
(Students finishing regular assignment in advance of the others may do other experiments on acidity listed below)
a. Litmus paper test.
b. Test for carbonates.

4. How does organic matter contribute to the availability of plant foods in soils?

    a. What three classes may the organic matter of the soil be divided?

    b. What is the effect of organic matter on the water holding capacity of soils?

    c. In what ways may organic matters be injurious to soils?

d. What are the sources of organic matters that may serve to increase the supply in soils?

e. In what way do the final products in the decomposition of organic matter increase the availability of plant food material in soil?

f. Examination of soil for organic matters.

Materials: Samples of soils, hand-lens, flame.

Procedure: Examine a soil rich in organic matter under the hand-lens. Observe character of the organic matter, its color, etc. Compare the structure of the soils high and low in organic matter. Place a small portion of soil rich in organic matter in the flame. Observe and explain the results. (Interested students may do an experiment on the estimation of organic matter.

5. How important is fertilizers to the maintainence of sufficient plant food material in soil?

   a. What are the forms in which nitrogen occurs in soils?
      1. Complete
         $CaO_2 + C$---$Co + ?$

b. What are fertilizer materials that contain nitrogen?
   1. Complete
      $CaC_2 + N_2$--$C +$

c. What crops are particularly benefited by nitrate fertilizers?
   1. Complete
      $CN.NCa + H_2O$--$CaCO_3 +$?

d. What are the effects of nitrogen on plant growth?
   1. Complete
      $NH_3 + H_2SO_4$--?

e. How does basic slag compare in availability with rock phosphate?

f. How is acid phosphate made, and how does it compare in availability with the natural phosphates?
   1. Complete
      $Ca_3(PO_4)_2 + H_2SO_4$--$CaSO_4 +$?

g. What occurs to a soluble fertilizer when applied soil?

h. Is there any indication that the use of sulfur as a fertilizer may be desirable?

i. How does the need of a soil for lime differ in principle from its need for other fertilizers?
   1. Complete
      $HNO_3 + Ca(OH)_2$--$Ca(NO_3)_2 +$?

j. How does lime affect the availability of certain other plant foods in soils?

Laboratory work: k. Analysis Of Fertilizer

Materials: Set of fertilizers--sodium nitrate, ammonium sulfate, cyanamid, dried blood, evaporating dish, phenoldi sulfonic acid, ammonia, funnel and filter paper, litmus paper, hand lens, flame.

Procedure: It is well for the student to be able to identify the common fertilizers and to know a few practical tests when the identity is in doubt.

Sodium Nitrate--This fertilizer appears in clouded light yellowish crystals, soluble in water andrather deliquescent. It has no marked odor.
Hold a crystal in the flame Note the brilliant yellow color. This is a test for sodium.
Test for nitrate part of the fertilizer by moistening a crystal in an evaporating dish, with a drop of phenol-disulfonic acid. Allow to stand and dissolve in water. Now neutralize with ammonia and obtain the yellow color characteristic of nitrates.

Ammonium Sulfate--This fertilizer is a light grayish colored salt, finely ground and soluble in water. Heat a little in an evaporating dish--Note odor of ammonia.

Cyanamid--Cyanamid is a fine dry black powder which carries besides its nitrogen compounds, carbon and lime. The carbon may be tested for by rubbing the fertilizer between the fingers. Dissolve as much of the fertilizer as possible in water, filter and test the filtrate with litmus paper. It should be intensely alkaline.

Dried Blood--This material can be easily identified and distinguished by their physical properties, especially if a hand lens is used. The odor is characteristic.

Probelms:

1. A commercial lot of sodium nitrate is guaranteed to be 91% pure. What is the least quantity of available nitrogen that should be contained in one ton of the substance?
2. A fertilizer is guaranteed to contain 2.43% of ammonia. This is equivalent to what percent of nitrogen?
3. A sample of tankage is guaranteed to contain 6 units of ammonia. What is the percentage content of nitrogen?

6. Charts and diagrams are to be drawn and collected by students. Specimen charts on pages 18--21 will be furnished to the students as guides for construction of t their own.

C Conclusion of Unit (Problem Section)

The student should write a resume of his reading on the unit.

1. The resume should be logically organized to cover all five main questions.
    a. The above can only be done if adequate attention is given to all the sub-questions.
    b. The resume should be read over several times by the student in order to become well acquainted with the facts of the assignment.
    c. The paper should be passed in to the instructor. If the work is satisfactory, the instructor will give an oral test based on the problems of the assignment sheet.
    d. The student should now have a very good understanding of the main ques- of assignment.

Additional Problems And Experiments

Problems:

1. Using any map of the United States as a base (colorless map with State boundaries) draw lines tracing roughly the regions occupied by residual, alluvial marine, glacial, Alolian soils.
2. How does the total quantity of plant-food materials in soils compare with the total weight of soil?
3. What are the sources of carbon dioxide in soil air?
4. What is the effect of potash oh plant growth?
5. What plant foods does farm manure contain, and what indirect fertilizing materials?

Experiments:

Soluble matter of soil.

Materials.-Soil, filter paper and funnel, evaporating dish, flame, dilute hydrochloride acid.

Procedure.-Place a small amount of the soil on a filter paper held in a funnel and wash with distilled water, catching filtrate in an evaporating dish, Evaporate filtrate to dryness and examine the residue. This soluble matter is the most valuable portion of the soil.

Zinc Sulfide Test for acidity.

Materials.-Soil, medium size Erlenmeyer flask, tripod and wire gauze, flame, calcium chloride zinc sulfide solution, lead acetate paper.

Procedure.-Place in Erlenmeyer flask a 10 gram sample (well pulverized) of the soil to be tested. Now add 5 c.c of the calcium chloride Zinc Sulfice reagent, the former being in solution and the latter in suspension. Add distilled water. Place over a flame and bring to boiling point. Boil exactly one minute, being careful not to allow the sample to froth over.

The boiling having become constant and CO_2 being driven off, lay over the mouth of the flask a strip of lead of acetate paper moistened with distilled water. Alow it to remain three minutes. The test is now complete and acidity is indicated by the blackening of the paper.

Examination and identification of Nitrogen fertilizers.

Materials.-Set of fertilizers (comprising sodium nitrate, ammonium sulfate, tankage). evaporating dish, Phenol-disulphuric acid, ammonia, funnel and filter paper, litmus paper, hand lens, flame.

Procedure.-Sodium nitrate--This fertilizer appears in clouded light yellowish crystals soluble in water and rather deliguescent. It has no marked odor.

Hold a crystal in the flame. Note the brilliant yellow color. This is a test for the element sodium.

Test for nitrate part of the fertilizer by moistening a crystal in an evaporating dish with a drop of phenol diSulphonic acid. Allow to stand a few minutes and then dissolve in a little water. Now neutralize with ammonia and obtain the yellow color characteristic of nitrates.

Ammonium Sulfate--This fertilizer is a light grayish colored salt, finely ground and soluble in water. Heat a little in an evaporating dish and note the odor of ammonia.

Cyanamid--Cyanamid is a fine , dry, black powder, which carries beside its nitrogen compound, carbon and lime. The carbon may be tested for by rubbing the fertilizer between the fingers. Dissolve as much of the fertilizer as is possible in water, filter and test the filtrate with litmus paper. It should be intensely alkaline on account of the lime it contains. The physical characters of the fertilizer are such as to make it easily recognized.

Dried Blood and Tankage--These materials can be easily identified and distinguished by their physical properties especially if a hand lens is used. Considerable hair and bone is likely to be found in tankage. The odor of both is characteristic.

Aids and References for Students' Use:

1. Cyril G. Hopkins, Soil Fertility and Permanent Agriculture; Ginn & Co., Boston, 1910
2. Brownlee, Fuller, Hancock & Whitsit, Chemistry of Common Things; Allyn & Bacon, Boston
3. R. A. Dutcher & B. E. Haley, Introduction to Agricultural Biochemistry; John Wiley & Son Inc., New York, 1932
4. T. L. Lyon, Soil and Fertilizers; The MacMillan Co., New York, 1918
5. W. T. Stratton & B. L. Remick; Agricultural Arithmetic, The MacMillan Co., New York, 1921
6. R. W. Thatcher, The Chemistry Of Plant Life; McGraw-Hill Book Co., New York, 1926
7. J. S. Chamberlain; Chemistry In Agriculture, The Chemical Foundation, Inc., New York, 1926
8. Reed, Rexford & Carroll, Useful Science For High School, The John C. Winston Co., Philadelphia, 1935
9. Black & Conant--Practical Chemistry, MacMillan Co., Boston, 1937
10. Howe and Turner, Chemistry And The Home, Chas. Scribner's Sons, Boston
11. Floyd L. Darrow, The Story Of Chemistry, Bobbs-Merrills Co., New York, 1930

TEST FOR UNIT

Mark each true statement with a plus sign on the line at the left of the statement. Mark each false statement with a zero. All omissions will be counted as wrong.

--1. The Process of soil formation is extremely slow.

--2. Rocks are mixtures of different minerals.

--3. One reason that building stones are more likely to disintegrate in a cold moist climate than in a dry or warm one is that small pores and cracks on their surface fill with water, which, when it freezed, exerts an enormous pressure.

--4. Water has an effect on rocks; it is a solvent, strong and universal.

--5. Glacial soils are productive, because of the thorough pulverization and mixing they have received.

--6. Phosphoric acid does not show great variation in respect to loss.

--7. Leached soils have the required amoung of lime for the profitable production of moist crops.

--8. Peat is of much agricultural value in Europe.

--9. Alluvial soil is found most largely along rather slowly flowing streams.

--10. Sand dunes and volcanic dust are two forms of Aeolian soils.

--11. The organic matter that has become incorporated with with the constitutuent of the soil is of very little importance.

--12. Organic matter forms acids.

--13. Organic matter is a source of plant-food material

--14. The first step in the control of organic matter in soil is to bring about decomposition.

--15. Unrotted organic matter is good plant food.

--16. Plants secure their mineral food materials from the soil and other sources.

--17. Sub soil never contain less plant food material than surface soil.

--18. Plant foods compose a small part of the soil.

--19. Various solvents have been used to determine the available plant-food materials.

--20. Acids will not form when organic matters is combined with soil.

--21. The plant-food materials lost in largest quantity are lime, magnesia, potash, nitrogen, and sulphur.

--22. The effect of both farm manure and commercial fertilizer is to increase the percentage of plant-food material in the drainage water.

--23. The composition of the drainage water seldom varies.

--24. The removal of crops from the land cause no serious loss to the soil.

--25. There is little doubt that a moderate supply of plant-food materials will always be available in most soils.

--26. Soils are termed acid or sour soils.

--27. Whether a soil is acid or not is a matter of practical importance.

--28. There are many kinds of soil acidity.

--29. Lime causes the injurious effect of acidity.

--30. The use of free sulfur for combatting fungous diseases may also lead to the formation of a sour soil.

--31. Whether a soil is acid or not will make a great deal of difference in the kinds of plants that will thrive on it.

--32. General farming can best be conducted on soil that is not greatly in need of lime.

--33. A rapid change to red when litmus paper is used to test for soil acidity indicates an acid conduction of the soil.

--34. Every soil is undergoing constantly decomposition.

--35. The composition of alkali does not vary greatly in different regions.

--36. Both with and black alkalis are injurious to plant growth when present in large quantity.

--37. Barley and oats are the most tolerant to alkali in soil.

--38. There is only one way in which the soil acidity may be injurious to plant growth.

--39. Most upland plants used in agriculture appear to absorb most of their nitrogen in the form of nitrates.

--40. Ammonia is generally found in soils.

--41. There are very few kinds of materials used to provide nitrogen in commercial fertilizers.

--42. Nitrate of soda is found in great material deposits in Mexico.

--43. Fertilizer is easily soluble in water and is readily absorbed by most farm crops.

--44. There is no great soruce of supply for ammonia sulfate.

--45. A pound of nitrogen in form of ammonia sulfate has slightly less value than thesame quantity in the form of nitrates.

--46. There are a great many materials containing organic nitrogen that are used as fertilizers.

--47. All of the plant-food materials contained in guano are in readily available condition, but its fertilizing value is low.

--48. Basic slay is a by-product in the manufacture of steel from pig iron rich in phosphorus.

--49. Materials used as potassium fertilizers with very few exceptions, are very insoluble in water.

--50. Sulfur is not one of the essential substances for plant growth.

COMPLETION

Insert the work or words that make the statement a true one,

51. If any one of the essential elements is lacking, no_________ life can exist.

52. Of the ten essential elements, carbon is derived from the______ ______ of the air.

53. The disintegration of feldspatric rocks results in the formation of_________ soil.

54. A substance added to the soil not because of the plant food it contains, but on account of the power it has to aid in the liberation of plant food from compounds containing it in unavailable forms is called an _________.

55. $CaO + 3C \xrightarrow{\quad} Cac_2 +$ _______

56. _____ $+ H_2SO_4$ _____ $(NH_4)_2SO_4$

57. $2HNO_2 +$ _____ $\xrightarrow{\quad} 2HNO_3$

58. $K_2O + 2HCl \longrightarrow H_2O +$ _______

59. The time when the uneducated and untrained man can be a successful_________is rapidly passing.

60. The farmer should have information concerning the sources and prices of_______materials.

61. Crops must be able to obtain from the soil an adequate supply of each of a few simple minerals elements in order to make a satisfactory_________ and come to complete_______.

62. Of the twenty or more mineral elements which are present in the soil only a few are________to plant growth.

63. Nitrogen is not of mineral origin as its ultimate source is the_________ .

64. In order to be available to plants, or to be utilized by them, the soil elements must become_______ in water.

MULTIPLE CHOICE

Place on the line at the left of the number the letter of the choice which makes the statement most nearly true.

65. It may be said that the whole process by which crops absorb mineral foods from the soils and with their aid build up carbohydrates, proteins, fats, etc., is a series of (a) physical changes, (b) chemical changes, (c) biological changes, (d) earthly changes, (e) atmospheric changes.

66. Plants take the great majority of the nitrogen essential to their growth from (a) the soil, (b) the atmosphere, (c) water, (d) the sunchine.

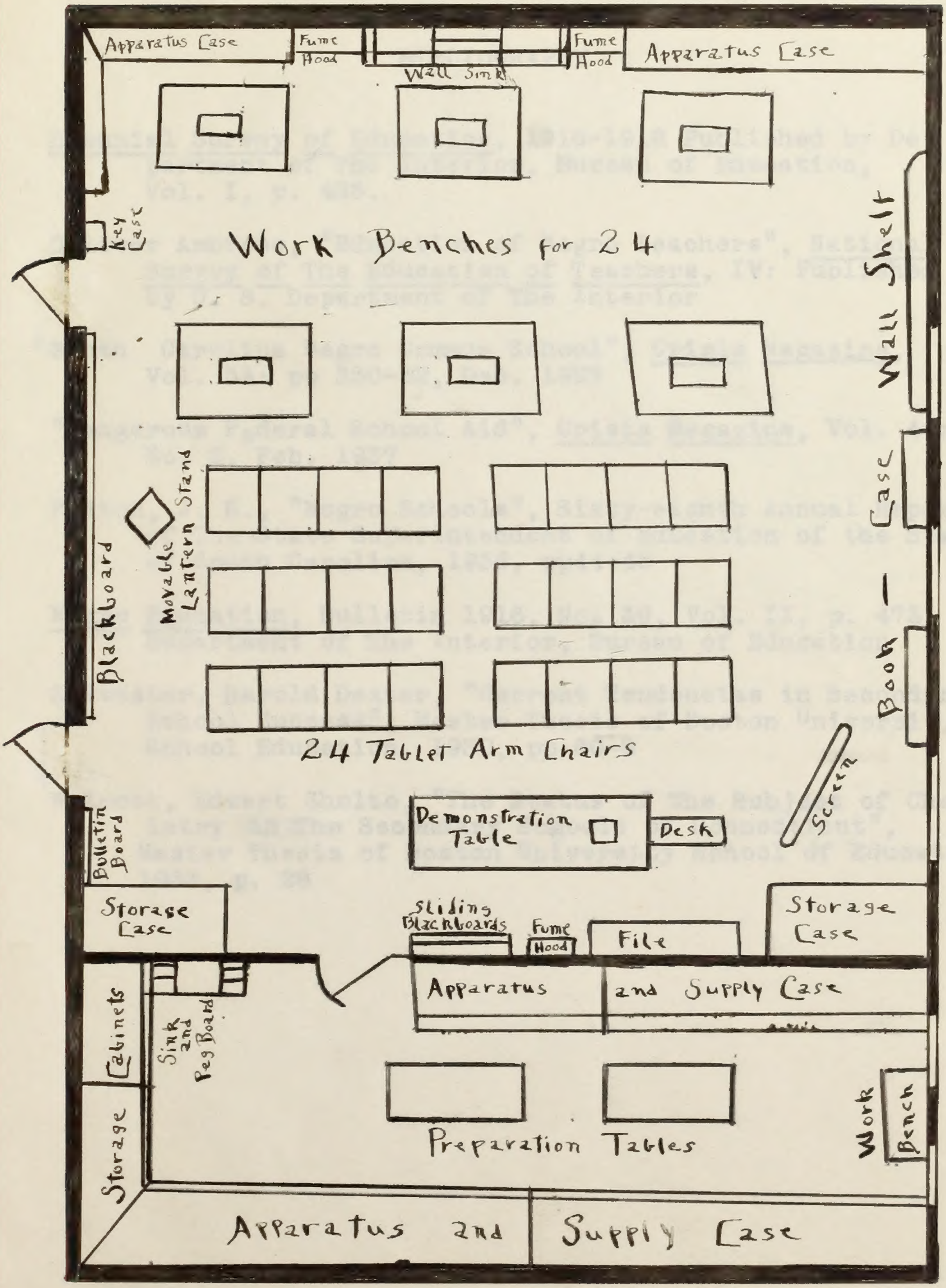
67. Soil formation is (a) rapid process, (b) limited process, (c) slow process, (d) gradual process.

68. Slaked lime is caustic in its action, that is, it destroys (a) nitrogen contents (b) plant foods (c) organic matter (d) phosphates.

69. For farm crops, bones have long been used as a source of (a) nitrogen, (b) oxygen (c) potash (d) phosphorus

70. Ammonia may be passed into sulfuric acid to form a valuable fertilizer, (a) ammonium sulfide (b) ammonium sulfite (c) ammonium bisulfate (d) ammonium sulfate.

IDEAL LAYOUT FOR CHEMISTRY DEPARTMENT[1]


Apparatus Case
Fume Hood
Wall Sink
Fume Hood
Apparatus Case
Key Case
Work Benches for 24
Wall Shelf
Book - Case
Movable Lantern Stand
Blackboard
24 Tablet Arm Chairs
Screen
Demonstration Table
Desk
Bulletin Board
Storage Case
Sliding Blackboards
Fume Hood
File
Storage Case
Apparatus and Supply Case
Cabinets
Sink and Peg Board
Storage
Preparation Tables
Work Bench
Apparatus and Supply Case

1./ Wolcott, Edward Sholto, "The Status of The Subject of Chemistry in The Secondary Schools of Connecticut", Master Thesis of Boston University School of Education, 1933, p. 28

BIBLIOGRAPHY

Biennial Survey of Education, 1916-1918 Published by Department of The Interior, Bureau of Education, Vol. I, p. 433.

Caliver Ambrose, "Education of Negro Teachers", National Survey of The Education of Teachers, IV: Published by U. S. Department of The Interior

"South Carolina Negro Common School", Crisis Magazine, Vol. 34: pp 330-32, Dec. 1927

"Dangerous Federal School Aid", Crisis Magazine, Vol. 44: No. 2, Feb. 1937

Felton, J. B., "Negro Schools", Sixty-eighth Annual Report of The State Superintendent of Education of the State of South Carolina, 1936, pp44-45

Negro Education, Bulletin 1916, No. 39, Vol. II, p. 475, Department of The Interior, Bureau of Education

Sylvester, Harold Dexter, "Current Tendencies in Secondary School Success", Master Thesis of Boston University, School Education, 1930, pp 80-8

Wolcott, Edwart Sholto, "The Status of The Subject of Chemistry in The Secondary Schools of Connecticut", Master Thesis of Boston University School of Education, 1933, p. 28

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